

# Maintaining a Careful Balance

In addition to removing excess water from the landfill, a VSEP RO membrane system provides an economical solution that can reduce operating costs for landfills considering hauling or evaporation.

■ By Greg Johnson

Operating a landfill is all about managing waste. This can take many forms. The solid waste is the one that people think of and associate with a landfill or dump. But this waste needs to be managed. The solid materials are sorted into green waste, household waste and industrial waste. There are also recycling materials that are segregated. The solid waste is processed, spread, compacted and covered. This is the primary function of a landfill, but managing this waste also includes some of the byproducts of waste burial. Being a bioreactor, the landfill will generate methane gas as the organic waste materials decompose. As liquid from the trash and rainwater enter the landfill, it percolates through the waste and is collected once it hits the liner at the bottom. This leachate must

also be managed. The water content in the landfill cell must be stabilized or liquefaction of the trash heap can occur resulting in slippage and failure of the cell.

Collecting and treatment of the leachate is an essential part of landfill operation. Some recirculation of the leachate can be beneficial as it can accelerate the decomposition and can improve generation of methane for extraction. Trash that is too dry will not decompose very quickly. But trash that is too wet can cause problems as well. A careful balance must be maintained. In any event, there will be excess water volume and there will need to be a treatment method and purge of this volume to maintain a proper water balance.

Samples of VSEP treated water and raw leachate. Images courtesy of New Logic Research.



## Leachate Treatment

Since a landfill is a bioreactor where bacteria and fungi break down organic materials into smaller and smaller molecules, the landfill itself acts to do some limited treatment of the leachate. But the leachate is far from suitable to discharge without further treatment. The most common method used is to treat the leachate using another biological digester to complete the decomposition and breakdown of the organic materials.

The smallest molecules at the end of complete decomposition are Carbon Dioxide (CO<sub>2</sub>) and Methane (CH<sub>4</sub>). Organic materials such as food waste contain complex molecules that all contain Carbon. During decomposition, the Carbon breaks down into the two smallest possible molecules of CO<sub>2</sub> and CH<sub>4</sub>. Oxygen is consumed as part of this process. This oxygen demand is measured as Biological Oxygen Demand or BOD. Biological digesters are designed to enhance this decomposition and to reduce the levels of BOD. But these digesters need stable conditions to operate well. An imbalance in nutrient levels needed by the organisms that promote decomposition can cause an imbalance in the treated water quality. Digesters are also less efficient in the presence of high levels of Chloride or other salts. They also lose efficiency in climates with high ambient temperatures. The effluent or treated water from biological digesters is rarely sufficient for release into the environment.

Membranes are being increasingly used to treat landfill leachate. Reverse Osmosis membrane that can be used to desalinate seawater can also treat leachate to not only remove BOD, but also remove heavy metals, Ammonia, recalcitrant organics such as pesticides, and all other potential pollutants. Because of the limitations on what can be fed to conventional spiral RO membranes, these are not commonly used to treat raw leachate. However, a vibrating RO membrane known as VSEP

Parameter	Leachate Value	VSEP Treated Water
Phosphorous	14.7 mg/L	0.3 mg/L
Cyanide	4.4 mg/L	0.02 mg/L
Chloride	3,430 mg/L	3.8 mg/L
BOD	22,380 mg/L	59.9 mg/L
Dissolved Solids	11,960 mg/L	163.8 mg/L
Oil and Grease	44 mg/L	0.4 mg/L

**Table 1:** The RO VSEP system installed is in general producing filtrate with all dissolve solids reduced by more than 98% and is producing water that meets rive discharge limits.

(Vibratory Shear Enhanced Processing) does not have these limitations and has been broadly used on raw leachate at several dozen landfills around the world.

A VSEP RO membrane system's unique design allows for membranes to be used to treat landfill leachate without the scaling and fouling problems of conventional membranes. Landfill leachate can vary a great deal depending on the age of the landfill, the waste received, the amount of rainfall and many other factors. Other technologies such as digesters, chemical treatment, or engineered wetlands can have selective success, but none represent a complete treatment solution. Only RO membranes are able to remove nearly all contaminants in the leachate and only VSEP with its vibratory shear can achieve high flow rates and volume reduction using RO membranes.

## Case Study: El Guabal Landfill—Yotoco, Colombia

The El Guabal sanitary landfill is located in the municipality of

**Engineered for the extreme**

**BRAWLER SERIES**

MAXIMUM TIRE LIFE    MAXIMUM UPTIME    MAXIMUM VALUE

Designed to meet the demands of the scrap and waste industry, Trelleborg's construction products combine premium compounding and advanced tire design to maximize uptime.

Our solid Brawler series provides the best in value, durability and safety. In addition, our extensive pneumatic offerings deliver maximum performance, comfort and fuel consumption.

When you choose Trelleborg, you choose a one-stop-shop partner to keep the business moving.

**TRELLEBORG**

[www.trelleborg.com/wheels](http://www.trelleborg.com/wheels)

**CLICK HERE FOR MORE INFORMATION!**



Top: Leachate storage pond.  
Left: VSEP System installed at El Guabal Landfill.

Yotoco, Colombia. This landfill receives 72,000 tons of solid waste every month from 28 surrounding towns. Previously, this landfill installed a treatment process consisting of a primary step of flocculation and clarification followed by an anaerobic digester and then an aerobic digester. The digester effluent then goes to an additional clarifier, then bleach treatment and finally carbon filtration. After this treatment, the effluent was discharged at a rate of 8 liters per second (126 gpm) to the Cauca River. This treatment process was having trouble consistently complying with the discharge rules and upon further examination, the local authorities introduced new limits for chlorides and other things that were currently not being met by the existing treatment process.

As a result, the landfill sought solutions and selected a VSEP RO system with a second stage RO spiral system that is used for polishing. With this new process, the effluent is able to meet all of the requirements for surface water discharge and in fact nearly meets drinking water standards.

### Process Description

A full-scale automated VSEP system was installed at this site using three VSEP modules. The permeate from the VSEP was then sent to a second stage RO spiral system to polish the water to meet the new limits for Chlorides and BOD. The landfill currently blends the VSEP treated water with the existing system treated water to feed a spiral polishing system. Because of the dilution effect from the VSEP water, the combined effluent can be fed to a spiral and the final water complies with the limits for discharge. In the future, the VSEP system will be expanded to 6 modules to double the VSEP capacity and at that point, the existing

system will be discontinued and only VSEP RO treated water will be discharged.

The concentrate obtained from the filtration process is collected and is recirculated back to the landfill. A proper water balance is maintained and the VSEP system is removing more water than is arriving at the landfill. The moisture content of the trash is monitored and controlled at a constant level to promote a good rate of decomposition.

### Separation Quality

An installed RO VSEP system is in general producing filtrate with all dissolved solids reduced by more than 98 percent and is producing water that meets river discharge limits. The membrane is also removing more than 98 percent of heavy metals including Cadmium, Zinc, Cobalt, Chrome, Iron, Nickel, Lead and others. The VSEP is also removing 100 percent of Fecal and other Coliform bacteria (see Table 1, page 49).

This landfill service company now has a competitive advantage and is in compliance with its discharge rules. Its experience with the VSEP system and the treatment of the leachate can be used at its other landfill operations and may also give it the advantage needed to secure other operation contracts in the region given its expertise in leachate treatment.

### An Economical Solution

A VSEP RO membrane system will allow a landfill to treat the leachate onsite and will produce water that can be surface water discharged or reused as water for dust control or irrigation. In addition to removing excess water from the landfill, the treatment process provides an economical solution that can reduce operating costs for landfills considering hauling or evaporation. | **WA**

*Greg Johnson is a chemical engineer and is currently CEO of New Logic Research (NLR) (Concord, CA), managing research and development, manufacturing, and engineering. He can be reached at [gjohnson@vsep.com](mailto:gjohnson@vsep.com).*